International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 1 Jan-Feb 2021, pp: 426-430 www.ijaem.net ISSN: 2395-5252

Recycling Lithium-Ion Battery

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Submitted: 15-01-2021 Revised: 27-01-2021 Accepted: 30-01-2021

ABSTRACT: Lithium-ion battery (LIB) applications in client physical science and hybrid and electrical vehicles square measure speedily growing, leading to boosting resources demand, together with atomic number 27 and metallic element. therefore, exercise of batteries is a necessity, not solely to say no the consumption of energy, however, conjointly to alleviate the shortage of rare resources and eliminate the pollution of venturesome parts, toward property industries associated with client physical science and hybrid and electrical vehicles. Analyzing exercise processes of spent LIBs, it introduces the structure and parts of the batteries, and summarize all accessible single contacts in batch mode operation, together with pre-treatment, secondary treatment, and deep recovery. in addition, several issues and prospect of the present exercise processes are bestowed and analyzed. it's hoped that this effort would stimulate more interest in spent LIBs exercise and within the appreciation of its benefits.

Key words: - lithium-ion battery, problems, prospect, recycling, waste.

I. INTRODUCTION

1. The rise in demand for energy in electrical and electronic devices furthermore as power hybrid and electrical vehicles considerably will increase battery consumption and so the utilization of materials that manufacture semi-permanent increase within the quantity of dangerous waste.
2. Similarly, electronic and electrical devices and metallic element - particle batteries are discarded at the stage of completion of the life cycle, passing from the world "electronic wonders of technology" to "electronic waste" within the absence of adequate policies and possible and economically viable technology, that permits for adequate usage of batteries. Thus, usage and recovery of the most parts of used metallic element - particle batteries appear that without delay is that the best thanks to stop environmental pollution and consumption of raw materials, or rather, a waste of rare and valuable raw materials.
3. Therefore, for an entire summary of the present state and prospects within the usage of waste metallic element - particle battery, it's necessary to 1st examine the structure and configuration of aforesaid batteries, so as to see the foremost acceptable method of separation and mechanical treatment, by analyzing the accessible incentives for usage of waste metallic element - particle battery, together with the number of waste metallic element - particle battery, the implementation of environmental protection measures from the side of the utilization and usage of metallic element - particle batteries, furthermore because the extraction and utilization of scarce materials within the construction of a metallic element - particle battery, that ought to be separated usage method, whereby within the 1st place thinking of metallic element and metal.
4. Through the outline of the usage method of waste metallic element - particle batteries are going to be consistently introduced within the pre-treatment usage of batteries, secondary treatment within the style of separation of the varied parts of the battery and therefore the final (deep) the method of usage of waste metallic element - particle battery, with a presentation of the most issues and challenges, the present usage technologies, furthermore as future prospects within the usage of metallic element - particle batteries.

STRUCTURE OF LITHIUM-ION BATTERY:

1. Unlike typical batteries, lithium-ion batteries don't use the reduction method for the creation and accumulation of electricity. Instead, the metal ions move between the anode and cathode, forcing electrons to maneuver with them. Basically, the lithium-ion batteries consist of cathode, anode, solution and

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extractor. additionally, inevitably, these sorts of batteries and have a protecting metal sheath, the protecting plastic part and the electronic management unit.

2. The basis for creating battery cathodes used on metal, whereas as a vigorous material used is sometimes a wider vary of composite materials, that contain metal, principally within the type of oxides. However, within the application of the assorted kinds of the metal composite, as an example metal metallic element chemical compound (LiCoO2), metal atomic number 25 chemical compound (LiMn2O4), metal nickel chemical compound (LiNiO2), metal V chemical compound (LiV2O3), moreover as admixtures of metal composites of metallic element, iron and phosphorus, i.e.. Li (NiCoMn) O2 and LiFePO4. However, the foremost common material for the assembly of cathodes represents a metal metallic element chemical compound, primarily thanks to its smart performance, touching on the high level of capability, which give, moreover because the short charging time, a comparatively long discharge time of battery.

THE PROCESS OF RECYCLING LITHIUM-ION BATTERY

1. In light-weight of the increasing use of atomic number 3 - particle batteries growing awareness of environmental protection, the employment of terribly valuable raw materials (elements) for the assembly of batteries and also the restricted resources of raw materials applied during this style of battery, inevitably, the necessity for application of extremely profitable, in each respect, the method use of atomic number 3 - particle batteries.
2. Phase pre-treatment of use batteries has been directed to the removal of sure venturous materials and separation of individual parts of the battery, to the best extent attainable. throughout the second part of use takes place the most method for the separation of materials from the device and also the method of decomposition. At the tip of the ultimate (deep) use method is targeted on the extraction of valuable and really rare material (e.g. the weather metal and nickel), which might be employed in creating new batteries, and different merchandise that contain these valuable materials. when effecting the 3 phases of use an atomic number 3 - particle batteries are obtained in the main metals, however additionally to metals and copper, aluminum, iron, cobalt, lithium, nickel, manganese, carbon, and varied plastics. Generally, metals like iron, Al and copper obtained in a very pure, elemental kind, whereas Co, nickel, atomic number 3 and metal are typically obtained within the variety of totally different compounds.

PRETREATMENT OF RECYCLING LITHUM-ION BATERY

1. Lithium - particle batteries are typically therefore complicated and sensitive structures to direct implementation pyrometallurgy, and hydrometallurgy procedures were extraordinarily inefficient, that are 1st applied pretreatment battery to stop harm to the loss of terribly valuable materials. so as to stop short-circuit the batteries, these should be utterly discharge. Pretreatment battery has been applied by mechanical, and manual (manual) separation of the individual elements and materials.
2. The anode and cathode will be manually separated when removal of the protecting shell (casing) of the terminals, followed by constant drying for twenty-four hours at a temperature of sixty °C. All actions within the pre-treatment are performed by trained personnel, with the obligatory use of protecting instrumentality (goggles, gloves, protecting respiratory masks) [19]. as an example, throughout this method, the most important quantity of copper provides in fractions of a size bigger than zero,59mm, Associate in Nursing copper is separated from the battery in a quantity up to ninety- three.1%. to extend the potency of the method, mechanical separation combined with crushing and reviewing obtained fragments battery. throughout the ultimate step of pre- treatment with the assistance of thermal processes, like transformation and incinerating stand out unwanted materials, so as to get the very best doable purity substances coming into the secondary treatment of utilization metal - particle battery, wherever as an example, 1st cathode components are heated to 150-500 °C for an amount of 1 hour to burn off the binder of materials and organic impurities, then to 700-900 °C for an amount of one hour, to get rid of primarily of carb

SECONDARY TREATMENT OF RECYCLING LITHUM-ION BATERY

1. After completion of the pre-treatment utilization of lithium- particle batteries are still

a precise quantity of anode and cathode material haven't been separated from Al and Cu foils. Figure four shows schematically secondary treatment utilization of used metallic element - particle batteries that mainly distinguished Cu, Cu resolution, Al, Al resolution, metallic element and carbon resolution.

2. Through a awfully controlled and progressive hydrothermal method may be consolidated LiCoO2 separation of waste batteries and regeneration of valuable compounds for the assembly of recent batteries. throughout this procedure, exploitation targeted Li-OH, at a temperature of two hundred °C with a gradual increase of temperature of three °C / min
3. Ultrasonic treatment has been principally used for the separation of cathode materials of the Al film
4. NMP represents a five-layered chemical stuff that codes for metallic element - particle batteries used for power increase adhesion of Al and Cu foils. within the secondary treatment method of battery utilization this composite has been separated by heating to one hundred °C, with concurrent separation of Al and Cu
5. In biological melting joined of the procedures that has been divided by individual scarce materials within the utilization of batteries, a key micro-organisms as iron compound and Sulphur oxide bacterium that show a noteworthy tendency to portion and preserve precious metals, a very metallic element and metallic element. This method is power assisted by sure compounds, such as: (NH4) two SO4, K2HPO4, MgSO4•7H2O, CaCl2•2H2O, FeSO4•7H2O, and the purity of obtained metallic element is regarding ninety-eight, whereas the purity of metallic element is regarding seventy-two.

FINAL TREATMENT OF RECYCLING LITHUM-ION BATTERY

1. Final (deep) treatment of utilization metal - particle battery combines the processes of solvent extraction, precipitation, electrolysis, and crystallization to get the very best purity materials, in addition as those most useful materials, that have did not get the previous phases of utilization batteries (manganese, nickel and cobalt) and has been shown schematically in Figure two.
2. Universal finishing the method of utilization metal - particle battery, that's the biggest application, mirrored in an exceedingly method in this 1st allocates metallic element in liquid answer, to allow a metallic element compound (MnO2) and metallic element hydroxide. Remainder of the method has been allotted nickel, by the compounds. At the top of the method within the universal stands, and metal within the type of a compound of Li2CO3. Cleanliness of the obtained part during this method is as follows: ninety-six.97% for metal, metallic element for ninety-eight.23%, 96.94% for Co and nickel ninety-seven.43%.
3. Improved the ultimate method of utilization metal - particle battery, that has been developed in recent years is that the pyrometallurgical method during which it's used and controlled discharge, acceptable characteristics, with the aim of getting the best fraction of metal and Co

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Table 1. COST OF TOTAL PROCESSING OF RECYCLING LITHIUM-ION BATTERY

s.no	Cost of new battery	Life span of battery	Resale value of battery	Process of recycling battery	Materials extract from battery	Cost of recycling process	
1	2,000/-	3-4 years	700-800	The process mainly: after discharging the recovered waste batteries, crushing, magnetic separation, air separation, crushing, gravity separation, screening and other processes are carried out by mechanical equipment.	**Lithium- Ion** Lithium-Sulphur Lithium-Oxygen Graphite Copper Aluminium Lithium- cobalt oxide	According to industry sources, the cost of recycling a lithium ion battery in India is about Rs 90-100/ kg	

Figure 1. Process flow chart of RECYCLING LITHIUM-ION BATTERY

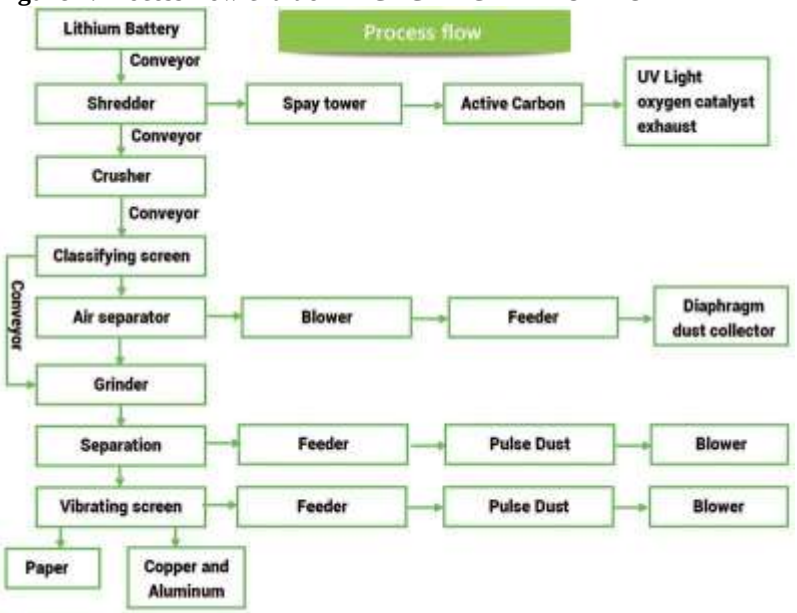

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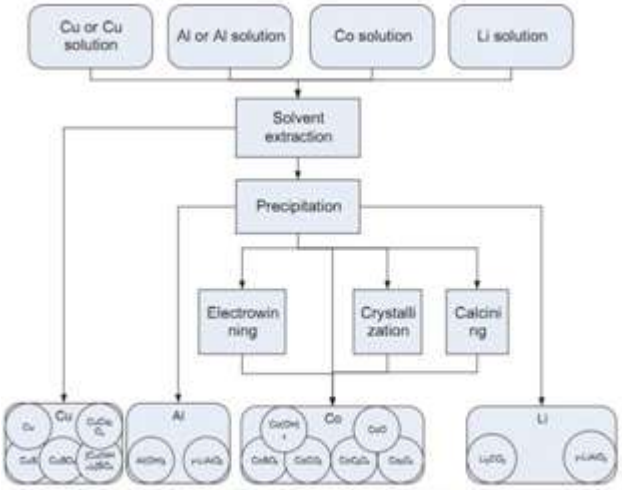
Figure 2. Deep (final) treatment recycling of used lithium- ion battery



II. CONCLUSION:

1. The increasing use of equipment and electrical machinery, and electrical and hybrid vehicles inevitably causes the increasing necessities relating to the employment of rare and valuable materials, like metallic element, lithium, copper or metal, that area unit utilized in the preparation of a Li - particle battery, that area unit the most supply of wattage these machines and appliances. On the opposite hand, used Li - particle batteries might explode or leak and cause harm to human health or the atmosphere pollution just in case of improper disposal or additional treatment, when finishing the life cycle.
2. shorten battery usage method whereas holding a high proportion purity of sorted materials,
3. introduction of additional machine-driven and software-controlled pre-treatment method of usage Li - particle battery,
4. development of subtle separation techniques notably rare materials, primarily at intervals the secondary and final treatment usage of batteries,
5. development and improvement of the system of collection used batteries, that area unit the topic of usage, each in technical - technological purpose of read, and within the legal - normative side in terms of legal rules and different rules.

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International Journal of Advances in Engineering and Management
ISSN: 2395-5252

IJAEM

Volume: 03 Issue: 01 DOI: 10.35629/5252

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